Translation of JP 8-165343

A PROCESS FOR PRODUCING A POLYOXYALKYLENEMONOAMINE

Inventors: Tohru Yasukohchi; Kozo Sanchika; Kenji Natsume, all of Kawasaki, Kanagawa, Japan.
Assignee: NOF Corporation, Tokyo, Japan

[Summary]

A process for producing a polyoxyalkylenemonoamine represented by general formula (1) $R^1O(C_2H_4O)_m(AO)_nC_3H_6NH_2$, which comprises: (1) a step of cyanoethylation of compounds represented by general formula (2) $R^1O(C_2H_4O)_m(AO)_nH$; (2) a step of hydrogenation of obtained cyanoethylated compounds (3) a step of purification of obtained hydrogenated compounds by ion exchange resin.

[Effect]

By keeping the rate of blockade of hydroxyl group low, polyacrylonitrile is not formed as a byproduct and a high purity polyoxyalkylenemonoamine, which is purified easily and suitable for the field of biochemistry, can be obtained.

What is claimed is:

1. A process for producing a polyoxyalkylenemonoamine represented by general formula (1) $R^1O(C_2H_4O)_m(AO)_nC_3H_6NH_2$, which comprises following (1) to (3) steps. (R^1 represents hydrocarbon or acyl group having 1 to 24 carbon atoms, AO represents oxyalkylene group having 3 or 4 carbon atoms, m and n each represents an average number of addition of an oxyethylene group and the oxyalkylene group; m=1 to 1000, n=0 to 1000 and m+n=1 to 1000; $\{n/(m+n)\} \leq 0.5$; when n is 1 or more, oxyethylene group and the oxyalkylene group can be arranged in a random order or in blocks.)

(1) Cyanoethylation step of polyoxyalkylene compounds as a starting material represented by general formula (2)

$R^1O(C_2H_4O)_m(AO)_nH$ (2)

(R represents hydrocarbon or acyl group having 1 to 24 carbon atoms, AO represents oxyalkylene group having 3 or 4 carbon atoms, m and n each represents an average number of addition of an oxyethylene group and the oxyalkylene group; m=1 to 1000, n=0 to 100 and m+n=1 to 1000; $\{n/(m+n)\} \leq 0.5$; when n is 1 or more, oxyethylene group and the oxyalkylene group can be arranged in a random order or in blocks.

(2) Hydrogenation step of obtained cyanoethylated compounds.

(3) Purification step of obtained hydorogentated compounds by ion-exchange resin.

2. A process according to claim1, wherein, in the cyanoethylation step, 1 to 50% by weight aqueous solution of alkaline catalyst chosen from potassium hydroxide, sodium hydroxide and lithium

19

hydroxide is added to a reaction mixture, the amount of which becomes 0.001 to 2 % by weight, and the reaction is conducted under the condition that the rate of blockade of hydroxyl group calculated from following equation (1) becomes 40 to 95%.

Equation (1);

The rate of blockade(%) = (Hydroxyl value of the compound before the reaction – remained hydroxyl value of the compound after the reaction)/(Hydroxyl value of the compound before the reaction) × 100 (1)

3. A process according to claim 2, wherein, in the hydrogenation step, Raney nickel catalyst is used and the reaction is conducted in the presence of ammonia.

4. A process according to claim 1 or claim 3, wherein, after the hydrogenation step, catalyst is removed by filtration and in the purification step, strong acid ion exchange resin is used.

5. A process according to claim 1 or claim 4, wherein, in the process for producing polyoxyalkylenemonoamine, (1) in the cyanoethylation step by acrylonitrile, acetonitrile used as reaction solvent is added in an amount of 100 to 500 % by weight of the compound represented by general formula (2), acrylonitrile is used 100 to 500% by mol of hydroxyl group of the compound represented by general formula (2) and the reaction is conducted at 10 to 50℃ in order to keep the rate of blockade calculated from equation (1) 40 to 95%. (2) After the cyanoethylation step, the catalyst is removed by an absorbent of alkaline, then acetonitrile used as solvent and acrylonitrile remained unreacted are removed at a decreased pressure. Raney nickel is used as a catalyst in the reduction step, and the reaction is conducted in the presence of ammonia at 100 to 200℃. (3) After the reduction step, the catalyst is removed by filtration, the compound represented by general formula (1) in the reaction mixture after reduction is absorbed by strong acid ion exchange resin, and the unreacted compound represented by general formula (2) is removed by washing with ion exchanged water. (4) After washing by ion-exchanged water, the compound represented by general formula (1) is released from ion exchange resin by 1 to 29% ammonium solution. (5) Concentration of the solution contained compound represented by general formula (1) is conducted by removing ammonia and water at a decreased pressure or by lyophilization.

[Field of the invention]

[0001]

The present invention relates to a process for producing a high purity polyoxyalkylenemonoamine, which does not contain polyoxylalkylene used as a starting material and polyamine formed as a byproduct in the process.

[Prior art of the invention]

[0002]

Some processes are known as synthesizing Amines from derivatives of polyoxyalkylene having

10

hydroxyl group; Such as, ① A process for producing Amine by reacting Ammonia and hydroxyl groups in the presence of hydrogen by using Raney nickel catalyst (JP 86-204225). ②A process for producing Amines by reacting hydroxyl groups and compounds having cyano group such as acrylonitrile and obtaining amine by hydrogenation by using cobalt compounds as a catalyst (JP 75-160214).

[Problems of the prior inventions]

However, in the process ①, . it is essential to react Raney nickel catalyst which contains at least more than 25% aluminum in the anhydrous condition at more than 200℃ so special reacting container is needed and this process has a defect that a minor reaction occurs such as decomposition of a starting material due to reacting at a high temperature. Process ② doesn't need special reacting container, but byproducts such as polyamine are produced due to reacting excess acrylonitrile in order to improve the rate of amination.

[0004]
Previously, polyoxyalkylenemonoamine was used for the fiber industry and resin additives, so the contamination such as an unreacted starting material and byproducts wasn't a serious obstacle. However recently, polyoxyalkylenemonoamines are used for the drug delivery system such as chemical modification of physiologically active protein and liposome, so a high purity polyoxyalkylenemonoamine, which contains little byproducts, is being required. In the process of ① and ② stated before, it was impossible to obtain a high purity polyoxyalkylenemonoamine easily. The present invention has an object of providing a process for an easily producible high purity polyoxyalkylenemonoamine, which doesn't contain unreacted raw materials or byproducts.

[Strategy for solving the problems]

When producing polyoxyalkylenemonoamine, the inventors found and completed that a high purity polyoxyalkylenemonoamine can be obtained by keeping the rate of cyanoethylation of polyoxyalkylene compounds low, controlling polyacrylonitrile formed as a byproduct and purifying by ion exchange chromatography after hydrogenation.

[0006]
The present invention is a process for producing polyoxyalkylenemonoamine represented by general formula (1) $R^1O(C_2H_4O)_m(AO)_nC_3H_6NH_2$, which comprises following (1) to (3) steps; (R^1 represents hydrocarbon or acyl group having 1 to 24 carbon atoms, AO represents oxyalkylene group having 3 or 4 carbon atoms, m and n each represents an average number of addition of an oxyethylene group and the oxyalkylene group; m=1 to 1000, n=0 to 1000 and m+n=1 to 1000; $\{n/(m+n)\} \leq 0.5$; when n is 1 or more, oxyethylene group and the oxyalkylene group can be arranged in a random order or in blocks.) (1)

40

cyanation of polyoxyalkylene compounds represented by general formula (2) $R^1O(C_2H_4O)_m(AO)_nH$ (R^1 represents hydrocarbon or acyl group having 1 to 24 carbon atoms, AO represents oxyalkylene group having 3 or 4 carbon atoms, m and n each represents an average number of addition of an oxyethylene group and the oxyalkylene group; m=1 to 1000, n=0 to 1000 and m+n=1 to 1000; $\{n/(m+n)\} \leq 0.5$; when n is 1 or more, oxylene group and the oxyalkylene group can be arranged in a random order or in blocks.)(2) hydrogenation of obtained cyanoethylated compound and (3) purification of obtained hydrogenated compound by ion exchange resin. Moreover, the present invention is distinctive in that in the cyanation process, 1 to 50% by weight aqueous solution of alkaline catalyst chosen from potassium hydroxide, sodium oxide and lithium hydroxide is added to a reaction mixture, the amount of which becomes 0.001 to 2 % by weight, and the reaction is under the condition that the rate of blockade of OH group calculated by following formula (1) becomes 40 to 95%.

Equation (1)

The rate of blockade(%) =(Hydroxyl value of the compound before the reaction – remained hydroxyl value of the compound after the reaction)/(Hydroxyl value of the compound before the reaction) × 100 (1)

Moreover, Raney nickel catalyst is used for the hydrogenation step and the reaction is conducted in the presence of ammonia. And after the process of hydrogenation, catalyst is removed by filtration and in the step of purifying, strong acid ion exchange resin is used.

[0007]

In the process for producing polyoxyalkylenemonoamine, (1) in the cyanoethylation step by acrylonitrile, acetonitrile used as reaction solvent is added in an amount of 100 to 500 % by weight of compound represented by general formula (2), acrylonitrile is used 100 to 500% by molar of hydroxyl group of the compound represented by general formula(2) and the reaction is conducted at 10 to 50℃ in order to keep the rate of blockade by equation (1) 40 to 95%. (2) After the step of cyanoethylation, catalyst is removed by an absorbent of alkaline and acetonitrile used as a solvent and acrylonitrile that is remained unreacted are removed at a decreased pressure. Raney nickel is used as a catalyst in the reduction process, and the reaction is conducted in the presence of ammonia at 100 to 200℃. (3) After the reduction step, the catalyst is removed by filtration, the compound represented by general formula (1) in the reaction mixture after reduction is absorbed by strong acid ion exchange resin, and unreacted compound represented by general formula (2) is removed by washing with ion-exchanged water. (4) Purification step after washing by ion exchanged-water, the compound represented by general formula (1) is released from ion exchange resin by 1 to 29% ammonium solution. (5) Concentration of the solution of compound represented by general formula (1) is conducted by removing ammonia and water at a decreased pressure or by lyophilization.

[0008]

Generally, formation of polyacrylonitrile as a byproduct is unavoidable in the cyanoethylation step of polyoxyalkylene having hydroxyl group. It is difficult to remove it completely before reducing by hydrogen and it is also very difficult to remove polyamine derived from polyacrylonitrile formed as a

byproduct stated before from polyoxyalkylenemonoamine after hydrogenation. It is characteristic of this invention to produce a high purity polyoxyalkylenemonoamine by keeping the rate of blockade represented by equation (1) 40 to 95%, controlling the reaction temperature at 10 to 50℃, using acetonitrile as reaction solvent in order to control the amount of polyacrylonitrile and removing polyoxyalkylene having unreacted hydroxyl group effectively in the purification step by ion exchange chromatography which ion exchanged water and alkaline solution are used as developing solvent.

[0009]

Starting materials used in the present invention are represented by general formula (2), R^1 represented hydrocarbon or acyl group having 1 to 24 carbon atoms. Examples of alkyl groups represented by R^1 having 1 to 24 carbon atoms contain saturated or unsaturated and unbranched or branched hydrocarbon groups such as methyl group, ethyl group, propyl group, isopropyl group, butyl group, isobutyl group, the third butyl group, pentyl group, isopentyl group, hexyl group, isoheputyl group, 2-ethylhexyl group, octyl group, isononyl group, decyl group, dodecyl group, isotridecyl group, tetradecyl group, hexadecyl group, isohexadecyl group, octadecyl group, isostearil group, oleyl group, octyldodecyl group, dococyl group, decyltetradecyl group, moreover, acyl group derived from saturated or unsaturated and unbranched or branched fatty acids are included in the example, such as acetic acid, propionic acid, butyric acid, isobutyric acid caprylic acid, 2-ethylhexanoic acid, isononyl acid, decanoic acid, lauric acid, myristic acid, palmitic acid, isopalmitic acid, stearic acid, isostearic acid, arachic acid, behenic acid, palmitoleic acid, oleic acid, linolic acid, linolenic acid, erucic acid.

[0010]

AO in the general formula (2) represents oxyalkylene group having 3 or 4 carbon atoms. Examples of this group include oxypropylene group, oxybutylene group, oxytetramethylene group. These oxyalkylene groups are formed by addition of alkylene oxide such as propylene oxide, 1,2-buthylene oxide, tetrahydrofuran. m and n each represents an average number of addition of an ethylene group and an oxyalkylene group. The number of m is at least 1 in order to keep the affinity with a living body, and when the number of m is more than 1000, it is not preferable because the compounds become solid and the efficiency of the work becomes bad. Moreover, when the number of n is more than 1000, the viscosity is increased, so it becomes hard to produce. And the number of {n/(n+m)} is limited less than 0.5. When the number of {n/(n+m)} exceeds 0.5, there is the possibility that the lipophilic property is enhanced, and the affinity with a living body is decreased. Preferably, the number of {n/(n+m)} is less than 0.3.

[0011]

In the cyanoethylation step of the starting material represented by general formula (2), alkaline catalyst chosen from potassium hydroxide, sodium hydroxide and lithium hydroxide is used. The concentration of the catalyst is 1 to 50% by weight, preferably, 1 to 10% by weight. When the concentration is less than 1% by weight, it is not preferable because water in the reaction mixture is increased and the reaction of water and acrylonitrile proceeds excessively, so the amount of byproduct is increased. And when the concentration of alkali is more than 50% by weight, it is not

20

preferable because alkali does not dissolve in water. The amount by weight of alkali used in the addition to the reaction mixture is 0.001 to 2 % by weight, preferably 0.5 to 1.5 % by weight. When the amount is less than 0.001% by weight, the reaction does not proceed sufficiently. And when the amount is more than 2 %, water in the reaction mixture is increased so the amount of byproduct is increased. Acrylonitrile used in the cyanoethylation step is 100 to 500%, preferably 250 to 450% by molar of the hydroxyl group of the starting material. Moreover, the amount of acetonitrile used as solvent is 100 to 500% by weight of the starting material. When the amount is less than 100% by weight, it is not preferable because byproducts such as polyacrylonitrile are formed. And when the amount of acetonitrile is more than 500% by weight, it is not preferable because it takes a lot of time to remove the solvent. The reaction temperature of the cyanoethylation is 10 to 50℃. When the temperature is less than 10℃, it is not preferable because the speed of the reaction is decreased and it takes a lot of time to react. And when the temperature is more than 50℃, it is not preferable because byproducts such as polyacrylonitrile are increased. The rate of blockade of the hydroxyl group of the starting material is 45 to 95%, preferably, 60 to 80%. When the rate is less than 45%, it is not preferable because the yield is decreased, and when the rate of blockade is more than 95%, it is not preferable because polyamine derived from polyacrylonitrile formed as a byproduct is increased and cannot be removed by purifying.

[0012]

The reaction temperature of the hydrogenation process is 100 to 200℃. When the temperature is less than 100℃, the reaction does not proceed sufficiently and when the temperature is more than 200℃, it is not preferable because secondary reactions such as decomposition of the starting material occur. The preferable temperature is 100 to 150℃. And in the step of hydrogenation, it is preferable to use hydrocarbon such as n-hexane and cyclohexane, aromatic hydrocarbon such as toluene and xylene as dilution solvent when it is needed in the point of physical property such as melting point and viscosity.

[0013]

Various kinds of structure can be used as an ion exchange resin as long as the resin is the type of base exchange resin because it is used to remove polyoxyalkylene having hydroxyl group from polyoxyalkylenemonoamine. Ion-exchanged water can be used to remove the compound represented by general formula (2) after absorption of the compound represented by general formula(1), and alkaline solution such as ammonium solution, potassium hydroxide and sodium hydroxide solution is used to release the compound represented by general formula(1) because stronger base than the product represented by general formula (1) is used to release from ion exchange resin. Ammonium solution is preferable taking the following concentration process into consideration.

[0014]

In the step of absorption and purification by ion exchange resin, ammonia or other alkali is used, and the concentration of the alkaline solution is not specified, but the concentration is 1 to 50% by weight, preferably 1 to 30%. Ammonia is the most preferable in the point of the following concentration step, and the concentration of the solution is 1 to 29% by weight. When it is less

20

than 1% by weight, it is not preferable because the amount of eluate is increased and the concentration process becomes crude. When it is more than 29% by weight, it is not preferable because it is difficult to obtain the solution and it needs to be treated at an increased pressure. The preferable concentration is 1 to 10% by weight. If the solution of sodium hydroxide or potassium hydroxide or lithium hydroxide is used, it is preferable to remove the alkali by dialyzing as necessity requires. The treated eluate is concentrated at a decreased pressure at low temperature or by lyophilization and the product is obtained. The treated eluate stated before can be used in the form of the solution as necessity requires.

[0015]

In the step of cyanoethylation of the present invention, polyacrylonitrile formed as a byproduct is controlled by keeping the rate of blockade of hydroxyl group 40 to 95%, and unreacted compounds represented by general formula (2) is removed by ion exchange chromatography. Therefore, the present invention is a process for producing a high purity polyoxyalkylenemonoamine easily without using special raw materials, reacting equipment and catalyst.

[0016]

The present invention is described in more detail with reference to examples and comparative examples.

[Example 1]

The compounds having the composition of the following preparing ingredients are placed in flask having four necks with reflux apparatus, a pipe which nitrogen is blown into, a thermometer, a stirring apparatus and a dropping funnel, and keeps the temperature at 30℃ under nitrogen atmosphere with stirring.

[Composition of preparing ingredients]

$CH_3O(C_2H_4O)_{113}H$ 1000g (about 0.2 mol)

Acetonitrile 2000g (200% by weight of the raw material)

10% sodium hydroxide solution 6g (0.6% by weight of the raw material)

[0017]

And then, 45g of acrylonitrile (0.85 mol, 425% by mol of hydroxyl groups of the raw material) mixed previously with acetonitrile was placed in the dropping funnel and it was added dropwise at 30±5℃ during 2 hours. After that, the solution was kept at the same temperature during 2 hours and 30g of an absorbent of alkali KW#700(Kyowa chemical industry Co. Ltd.) was added, and after stirring at the same temperature during 30 minutes, the catalyst was removed by pressure filtration. Next, unreacted acrylonitrile and acetonitrile used as solvent were removed at a decreased pressure of 5 to 30mmHg at 120±5℃, while nitrogen gas was blown into the solution and 970g of cyanoethylated methoxypolyethyleneglycol was obtained. The hydroxyl value of the obtained cyanoethylated methoxypolyethyleneglycol was 3.8 and the rate of the blockade of the hydroxyl group calculated from the hydroxyl value was 66.1%. The hydroxyl value was measured in accordance with the method of Japanese Industrial Standard K0070 (1992).

[0018]

The gel permeation chromatogram of methoxypolyethyleneglycol used as a starting material and

cyanoethylated methoxypolyethyleneglycol are shown in the figure 1 and figure 2 respectively. It was confirmed that polyacrylonitrile was not formed as a byproduct from figure 1 and 2. The conditions of the measurement of gel permeation chromatography were as follows:

Column: Shodex KF-801, KF-803, KF-804

Developing solvent: Tetrahydrofuran(THF)

Column oven temperature: 40℃

Sample concentration: 0.15(w/v)%

Injected amount of a sample: 10 μ l

Flow rate: 1.0ml/min

[0019]

Next, obtained 404.2g of cyanoethylated methoxypolyethyleneglycol, 200g of toluene and 18g of Raney nickel catalyst Ni-5136P(ENGLAND DE MEERN B.V) were placed in the autoclave for reducing by hydrogen. The temperature was kept at 60℃ while stirring and the pressure was increased to 7kg/cm^2 by ammonium gas. And then, the temperature was controlled at 130±10℃, hydrogen gas was added slowly and the reduction by hydrogen was conducted while keeping the pressure 35±5kg/cm^2. After decrease in pressure accompanied with proceedings of the reduction by hydrogen was considered to be finished, the material was kept during 2 hours at the same temperature, the reaction equipment was cooled to 70℃, and after that, the apparatus was returned to atmospheric pressure by blowing and ammonium gas was removed by blowing nitrogen gas. And after remained catalyst was removed by filtration, acetonitrile used as solvent and unreacted acrylonitrile were removed at a decreased pressure under the condition of 120±5℃, 5 to 30mmHg , and 367g of crude methoxypolyethyleneglycolmonoamine was obtained.

[0020]

The total amine value of the obtained crude methoxypolyethyleneglycolmonoamine was 7.1, the primary amine value was 7.1, the secondary and the tertiary amine value were 0, and purity of the crude methoxypolyethyleneglycolmonoamine calculated from the amine value was 63.5%. The amine value was measured in accordance with the following method:

[The measurement of total amine value]

Total amine value is mg of potassium hydroxide converted the amount of perchloric acid required for neutralization of 1g of sample by potentiometry using 1/10N perchloric-glacial acetic acid reagent, crystal violet reagent and glacial acetic acid reagent.

[The measurement of tertiary amine value]

Tertiary amine value is mg of potassium hydroxide converted the amount of perchloric acid required for neutralization of 1g of sample by potentiometry using 1/10N perchloric-glacial acetic acid reagent, crystal violet reagent and mxture of glacial acetic acid and acetic anhydride.

[The measurement of total of secondary and tertiary amine value]

The total of secondary and tertiary amine value is mg of potassium hydroxide converted the amount of chrolic acid required for neutralization of 1g of sample by potentiometry using 1/10N hydrochloric acid-ethanol reagent and bromcresol green reagent after salicylaldehyde was added to the sample and reaction with the primary amine was proceeded.

10

[The measurement of secondary amine value]

Secondary amine value is calculated by subtracting the tertiary amine value from the total of secondary and tertiary amine value.

[The measurement of the primary amine value]

Primary amine value is calculated by subtracting the total of secondary and tertiary amine value from total amine value.

Next, liquid chromatogram of a crude methoxypolyethyleneglycolmonoamine is shown in the figure3. The condition of the liquid chromatogram is as follows:

column: TSKgel SP-5PW(TOHSO Co. ltd)

developing solvent: a 2mM phosphate buffer solution (pH 7.4)

column oven temperature: 30℃

sample concentration: 0.5(w/v)%

injected amount of a sample: 20 μ l

flow rate: 0.5ml/min

[0021]

The column was filled with 100g of the type of basic ion-exchange resin treated which was regenerated by established method, 10g of a crude methoxypolyethyleneglycolmonoamine was dissolved into 90g of ion exchanged water, and it was flowed to the column at a speed of 0.8ml/min. When the surface of the column became the same level of a border of the filled resin, 1l of ion-exchanged water was flowed at a speed of 3.3ml/min, and then, 0.5l of 5% ammonium solution was flowed at a speed of 0.8ml/min, and 550ml of the eluate was obtained. Next, 8g of an objective high purity methoxypolyethyleneglycolmonoamine was obtained by lyophilizing the obtained eluate. The total amine value of obtained methoxypolyethyleneglycolmonoamine was 10.9, the primary amine value was 10.9, the secondary and tertiary amine values were 0. The purity of the methoxypolyethyleneglycolmonoamine calculated from the amine value was 97.6%. A liquid chromatogram of the obtained methoxypolyethyleneglycolmonoamine is shown in the figure 4. It is confirmed from the figure 4 that a purity of the obtained methoxypolyethyleneglycolmonoamine is high. The following equation was used for converting the amine value into purity.

Purity(%)=(A/B) × 100 (2)

There, A and B indicate as follows

A: the measure primary amine value

B: theoretical primary amine value calculated from a starting material

Polyoxyalkylene compounds used as starting materials are shown in the Table1 and obtained polyoxyalkylenemonoamine are shown in the Table2.

Table 1

Examples or comparative examples		Compounds used for examples or comparative Examples
Examples	1	$CH_3O(C_2H_4O)_{113}H$
	2	$C_{18}H_{35}O(C_2H_4O)_{90}H$
	3	$CH_3O\ (C_2H_4O)_{22}H$
	4	$CH_3O\ (C_3H_6O)_{17}H$
	5	$CH_3COO(C_2H_4O)\ _{113}H$
	6	$C_{17}H_{33}COO(C_2H_4O)_{90}H$
	7	$CH_3COO(C_2H_4O)_{90}H$
Comparative examples	1	$CH_3O\ (C_2H_4O)\ _{113}H$
	2	$CH_3O\ (C_2H_4O)\ _{113}H$
	3	$CH_3O\ (C_2H_4O)\ _{113}H$

Table 2

Examples and comparative examples		Reaction solvent		Amount of acrylonitrile (% by mol)	The blockade of hydroxyl group(%)	Results of GPC	Purity of crude products (%)	Purity of products (5)	Yield (%)
		kinds	Amount (%)						
Examples	1	Acrylo-nitrile	200	425	66.1	No accessory ingredients	69.5	97.6	65.1
	2	Ditto	200	425	82.7	Ditto	80.6	98.7	80.2
	3	Ditto	200	425	91.1	Ditto	86.1	99.1	87.0
	4	Ditto	200	425	52.1	Ditto	51.3	98.2	48.5
	5	Ditto	200	425	69.5	Ditto	67.2	95.8	60.1
	6	Ditto	200	425	72.8	Ditto	70.8	97.2	65.8
	7	Ditto	200	800	60.3	Ditto	58.9	98.1	55.2
Compara-tive Examples	1	Toluen e	200	425	13.5	Ditto	4.8	68.5	4.0
	2	Aceto-nitrile	200	850	98.5	Containing accessory ingredients	105.6	116.6	91.5
	3	Ditto	50	425	88.8	Ditto	109.2	110.5	85.6

[0024]

The result of GPC represents the gel permeation chromatogram and the indications are as follows:

No accessory ingredients: There are no accessory ingredients other than the main ingredient

Containing accessory ingredients: There are some accessory ingredients other than the main ingredient.

The purity of crude and purified products is calculated from the equation (2) stated before which is converted the amine value.

[0025]

By the same method as the example1, polyoxyalkylenemonoamines that are equivalent to the compounds represented by general formula (2) were obtained. The results are shown in the Table2.

[0026]

By the same method as example 1, the reaction was conducted by using compounds represented by general formula (2). In this time, the reaction solvent was converted to toluene from acetonitrile in the cyanoethylation process. The results are shown in the Table 2.

[0027]

By using the compounds represented by general formula(2), and converting the amount of dropping of acrylonitrile into 90g in the cyanoethylation process, cyanoethylated methoxypolyethyleneglycol which the rate of the blockade is 98.5% was obtained. The results are shown in the table2.

[0028]

The reaction was conducted with the same method as the example 1 except that 500g of acetonitrile instead of 2000g before preparing acrylonitrile in the cyanoethylation process of example1 is used.

[0029]

It is confirmed from the above mentioned examples and comparative examples that a high purity polyoxyalkylenemonoamine can be obtained by the producing process of the present invention.

[0030]

Figure1 shows the gel permeation chromatogram of a methoxypolyethyleneglycol use as a starting material of example1.

Figure2 shows the gel permeation chromatogram of a cyanoethylated methoxypolyethyleneglycol of example1.

Figure3 shows the liquid chromatogram of a crude methoxypolyethyleneglycolmonoamine of example 1.

Figure4 shows the liquid chromatogram of a methoxypolyethyleneglycolmonoamine of example 1.